PDE Computational Simulations

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Overview

We have developed two primary numerical simulations to aid in the setup and interpretation of the data from our optical diagnostic experiments. The first code is a fully implicit, 2-D Navier-Stokes solver. This code is useful in our assessment of viscous and heat transfer effects on the PDE. Some results from this code are presented in Figures 1 and 2. The second code is a fully explicit quasi-1D Euler solver. Both this code and the 2-D code use a flux difference splitting algorithm on the convective fluxes. The quasi-1D code produces results in very close agreement with the 2-D code under typical run conditions and at a fraction of the computational expense. Accordingly, this solver is used extensively, especially for quick parametric studies. Both simulations employ frozen chemistry and a characteristics based outflow boundary condition.

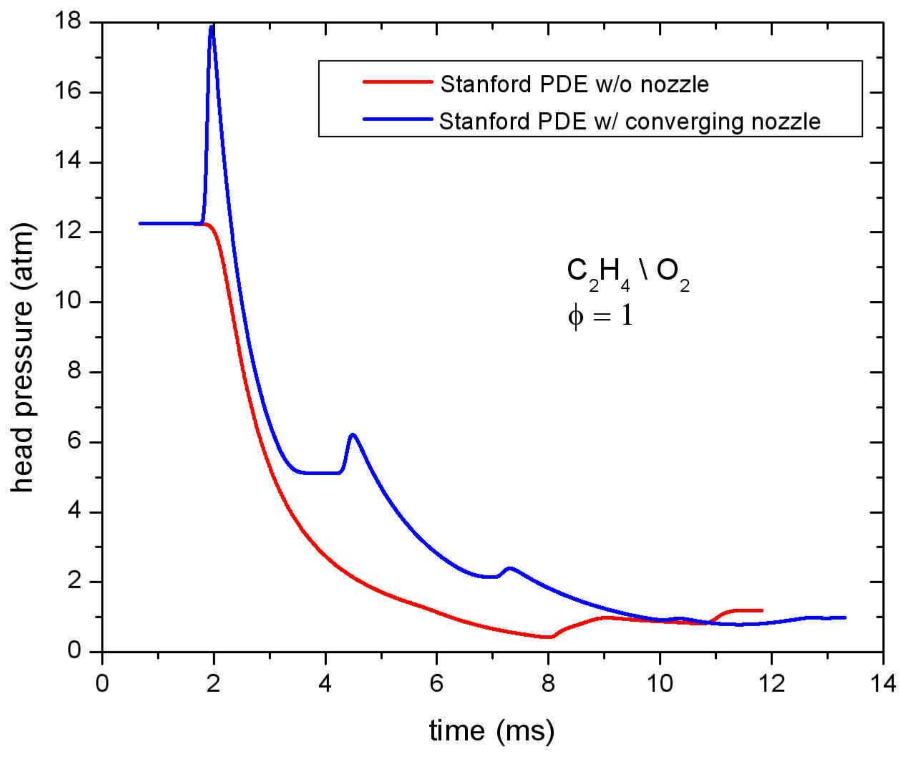

Figure 1: Simulated head end pressure for both straight-tube and converging nozzle PDE configurations

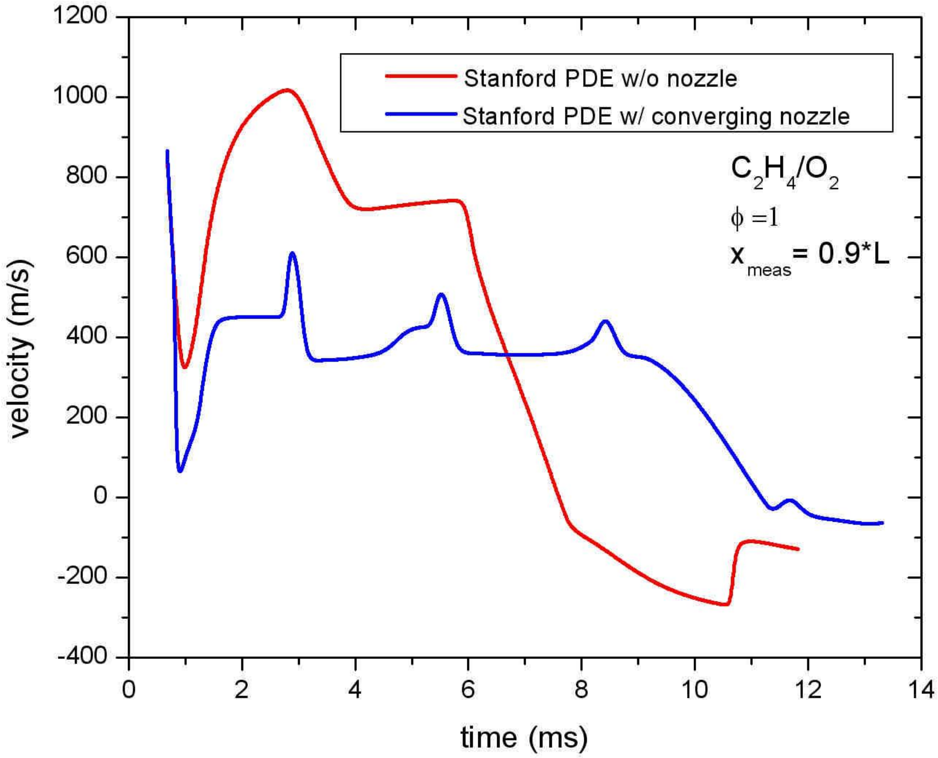

Figure 2: Simulated burned gas velocity at location at 90% tube length station for straight-tube and converging nozzle PDE configurations

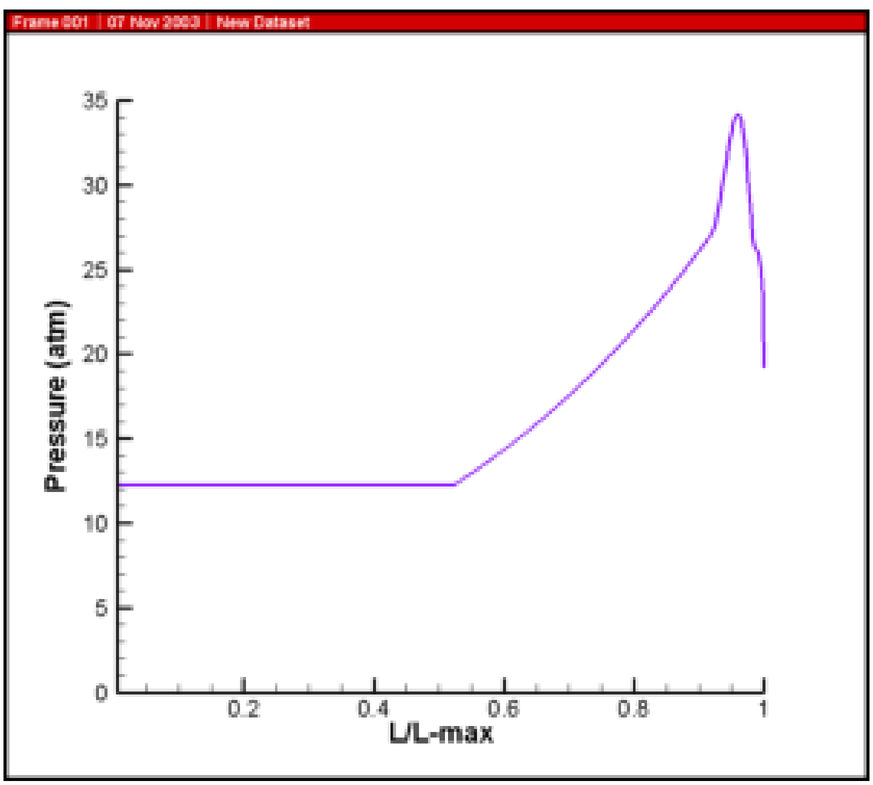

Figure 3: Simulated pressure in PDE with converging-diverging nozzle